GEOLOGY FOR PLANNING IN NORTHEASTERN ILLINOIS

V. GEOLOGY FOR PLANNING IN COOK COUNTY

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INTRODUCTION

With a total population exceeding 4 million, Cook County includes the city of Chicago and has been a major residential, commercial, and industrial center for many decades. Developmental pressures, which are now being experienced by the surrounding counties, have been a fact of life in Cook County since the middle of the last century. Outlying suburban areas of the County remain primarily residential, but are sprinkled with enclaves of more intensive commercial and industrial development.

Purpose and Format

An understanding of the physical environment, including man's impact upon that environment, provides an essential basis for planning decisions affecting the quality of urban and suburban life in future years. Therefore, a major purpose of this report is to identify and map the distribution of geologic materials which man utilizes as resources, upon which he builds his structures, and into which he disposes of his domestic and industrial wastes.

As a major urban center, Chicago and surrounding areas of Cook County rely heavily on both ground water and surface water resources. The potential for pollution of these resources is intensified by the volume and variety of waste products generated. Thus, a second major objective of this report is to examine geologic conditions in relation to various waste disposal and land treatment practices in order to determine where a significant potential exists for contamination of either ground water or surface water resources.

The format for this report on Cook County is identical to the format of other reports in this series for the remaining five counties of Northeastern Illinois. The geologic framework of the area, the project scope, funding, mapping criteria, and mapping procedures were described in Volume 1. The deletion or modification of specific maps pertaining to Cook County will be described in succeeding sections of this report.

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GEOLOGY

Glacial till and related glaciolacustrine and glaciofluvial deposits are the major geologic materials deposited on top of the Silurian dolomite bedrock in Cook County. Locally, the glacial deposits are mantled by accretionary materials deposited in depressions on the till surface or by alluvium deposited in stream valleys. The eastern portion of the county has very low relief and was the former site of Lake Chicago, an expanded Lake Michigan, which was a prominent feature of the area during early post-

lake and reached a maximum elevation of approximately 640 feet above sea level about 13,000 years before present. The presence of Lake Chicago is documented by the widespread area of flat topography, scattered lacustrine deposits, and sandy beach ridges associated with former shorelines. The western and northern portions of Cook County consist mainly of morainic upland with drainageways generally flowing north-south between the moraines. In the southwest part of the county, the Tinley and Valparaiso Moraines are transected by the Sag and Des Plaines Valleys, which were the major outlets through which Lake Chicago drained to the southwest.

For a more complete description of the geologic history of Cook County and the Chicago area, consult Willman (1971). The original geologic mapping of the area was done by Alden (1902) and greatly expanded by Bretz (1939 and 1955). The general stratigraphy and age relationships of the mapped geologic materials, including the bedrock, are shown in Figures 1 and 3 in Volume 1, while a detailed discussion of the bedrock is given in Willman (1971). The engineering properties of geologic materials in the Chicago Metropolitan Area were studied by Peck and Reed (1954). The groundwater geology of the area is summarized in Suter et al. (1959).

Geologic Materials to a Depth of 20 Feet

In Cook County, there is generally a vast amount of available subsurface information; consequently, most of the data utilized for geologic mapping in the county consisted of engineering borings selectively chosen to provide good data distribution. Detailed soils mapping of suburban Cook County by the SCS, which was in progress as this report was being compiled, was also utilized. In addition, published information regarding the distribution of both geologic materials and man-made fills was consulted; major sources were Alden (1909) and Bretz (1955). Other sources include Peck and Reed (1954), Peck (1948), Andreas (1885-86), Shroeder (1964), and City

of Chicago (1926 and 1973). Geologic materials mapped to a depth of 20 feet are shown on Plate 1. For detailed description of the geologic units in alphabetical order, consult Table 1 in Volume 1. Data on the physical properties of major mapped units are given in Table 1. In this report, the deposits will be discussed by groups of genetically similar materials, including made land and land influenced by man's activities, glacial tills, outwash deposits, lacustrine materials, depressional deposits and alluvium, Lake Michigan deposits, and bedrock.

Fills, Made Land, and Land Disturbed by Extractive Operations

Because of extensive urbanization, there are many areas in Cook County where geologic materials have been affected by man's activities. Major extractive operations in the county include clay pits, dolomite quarries, and sand and gravel pits; these are mapped sm on Plate 1. Due to the urban nature of the county, only major fills were indicated on both the original $7\frac{1}{2}$' quadrangles and on Plate 1; these are mapped as m. However, it is recognized that a few feet of miscellaneous fills and/or regraded topsoil and other surficial materials may underlie most of the Metropolitan area (see Note on Plate 1). Specific mapped fills include the central Loop area, the West Fork and a portion of the main channel of the South Branch of the Chicago River, and portions of Lake Calumet. Generally, large sanitary landfill operations, areas where land disturbed by extractive operations has been filled by foreign materials (including various non-earth materials), sites where industry tailings or incinerator wastes have been stockpiled, canal spoil banks, and made land areas along the Lake Michigan shoreline also qualify as mappable fills. A made-land area along the lakeshore which lies immediately north of the mouth of the Chicago River actually includes a significant percentage of sand deposited naturally by longshore drift. Deposition was initiated by the construction of dock facilities during the

TABLE 1

Physical and Mineralogical Properties of
Geologic Units Mapped in Cook County

Units		Data										
		N	qu	w	δd	Gvl	Sd	St	Cl	M	I	C-K
Henry Formation	$\bar{X}$	22	-	-	-	23	66.4	21.1	12.5	-	-	-
Mackinaw and Batavia	n	20	-	-	-	20	20	20	20	-	-	-
Members (hm & hb)	R	3-36	-	-	-	0-63	48-91	8-49	1-26	-	-	-
Equality Formation	$\bar{X}$	14	1.6	31.2	-	.2	5.3	51.2	44.5	12	71.8	16.4
Carmi Member (ec)	n	10	11	15	-	18	18	18	18	7	7	7
	R	1-29	1-3.1	13.8-54	-	0-2	0-30	16-72	11-84	2-18	65-80	12-19
Wedron Formation	$\bar{X}$	25	4.2*	16.8*	114.6*	4.6	13.6	43.5	42.9	6.4	75	18.6
Wadsworth Till	n	90	117	128	41	180	180	180	180	45	45	45
Member (ww)	R	8-72	.5-13	7.2-28	109.1-119.3	0-29	0-69	29-86	10-73	3-12	70-79	15-22

Explanation of Symbols:

$\bar{X}$ = mean
n = number of tests
R = range of data: low value - high value
N = number of blows per foot (Standard Penetration Test)
qu = unconfined compressive strength in tons per square foot
w = natural moisture content in percent
δd = dry density in pounds per cubic foot
Gvl = percent of gravel in total sample
Sd
St } = percent of sand, silt and clay, respectively, in < 2mm fraction of sample
Cl
M = percent montmorillonite and expandables in clay fraction
I = percent illite in clay fraction
C-K = percent chlorite plus kaolinite in clay fraction

Data for several mapped units are not available for Cook County.

* In Chicago Loop area, available data show moisture content about 24%, dry density 104 lb/ft^3 and qu generally less than 1 ton/ft^2

1830's which consisted of two piers perpendicular to the shoreline. These piers effectively trapped sediment north of the river mouth while sediment-starved areas immediately south of the river mouth were severely eroded; the latter were reclaimed and extended by later landfills. In many areas of Cook County, clay pits excavated by the brick and tile industry have been utilized as sanitary landfills and are now mapped m rather than sm. Borrow pits and roadway and railroad embankments are generally not mapped because of scale limitations.

Till

Wedron Formation

Wadsworth and Yorkville Till Members (ww and wy). Wadsworth Till is a silty clay till that is gray when unoxidized; when oxidized in its upper part, it varies from yellow to olive brown. It is the major surficial till unit mapped in Cook County and is considered to be the youngest till which occurs in Illinois. Wadsworth Till mantles the morainic uplands and, where lacustrine deposits are absent, lies at the surface over much of the old Lake Chicago Plain. Any physical distinction in the subsurface between the Wadsworth Till and the older silty clay textured Yorkville Till is extremely tenuous; thus, even in areas where the drift sequence thins and Yorkville Till may occur within 20 feet of the surface, it is generally not mapped separately. Over much of the county, the Wadsworth and Yorkville Tills form a relatively thick sequence of uniform silty clay tills separated by discontinuous lenses of outwash sand and gravel or lacustrine silt and clay.

Haeger Till Member (wh). The Haeger Till is a gray, sandy, gravelly silt till which is mapped only in extreme Northwestern Cook County. The Haeger occurs extensively in McHenry and extreme northeastern Kane Counties, where it is generally thin and overlies a continuous deposit of associated outwash. The

Haeger Till overlies the silty clay Yorkville Till and is thought to be intermediate in age between the Wadsworth and the Yorkville Tills.

Malden Till Member (wm). The Malden Till, a gray (when unoxidized) sandy silt till, is mapped only along the Des Plaines Valley where boring and outcrop information is abundant. A correlation between the Malden Till Member and the till associated with the Lemont Drift (described by Bretz, 1955, and Horberg and Potter, 1955) has been proposed (Bogner, 1973) and is in the process of being verified for this area.

Outwash Sand and Gravel

Sand and gravel outwash which lies stratigraphically above the Wadsworth Till is assigned to the various members of the Henry Formation according to its geometry, lithology, and landscape position. Outwash sand and gravel interbedded between Wedron Formation tills is designated w-o.

Henry Formation

Mackinaw Member (hm). The Mackinaw Member, which is restricted to valley train deposits, includes most of the postglacial outwash mapped in Cook County. The Northern and Southern Des Plaines Valleys and the Sag Valley (now occupied by the Calumet-Sag Channel and the Sanitary and Ship Canal) contain extensive deposits of valley train sand and gravel. In the Southern Des Plaines and Sag Valleys, the occurrence of rounded elongate gravel deposits indicates the position of former river bars in the braided meltwater stream. These are designated by hm-b. In the Northern Des Plaines Valley, similar features are designated (-b) because data are generally unavailable to suggest that the deposits are extremely coarse-textured.

Batavia Member (hb). The Batavia Member includes all postglacial sand and gravel deposited as outwash plains. Outwash plains are generally limited to the northwestern portion of Cook County where they occur in intermorainic areas.

Wasco Member (hw). The Wasco Member includes poorly-sorted outwash deposited as kames, eskers, or kame terraces. There is no Wasco Member mapped in southern Cook County -- several small areas along the Sag Valley which Bretz (1955) suggested were kames or eskers were not verified by more recent data. Hummocky areas at the margin of the Haeger Till (wh) in extreme northwest Cook County include some kamic sand and gravel which is included in the Wasco Member.

Wedron Formation outwash (w-o). Most Wedron outwash (w-o) mapped in Cook County consists either of basal outwash overlying the bedrock surface or outwash associated with Lemont Drift deposits (Bretz, 1955) in southwest suburban areas of the county. Some of the Lemont Drift outwash is also basal.

Lacustrine Deposits and Associated Wind-Blown Sand

Most of the lacustrine deposits mapped in Cook County were deposited under the waters of Lake Chicago. Glacial and early post-glacial lacustrine deposits are collectively mapped as the Equality Formation, with individual member distinctions based on whether the deposits are predominately fine-grained lake bottom sediments (Carmi Member) or coarser-grained shoreline and delta deposits (Dolton Member). Wind-blown sand deposited on the beach ridges of Lake Chicago is mapped as the Parkland Sand.

Older lacustrine deposits interbedded with the Wedron Formation tills are designated w-l. Data suggest that w-l units may be quite continuous in the subsurface between various tills in the Chicago Metropolitan Area.

Equality Formation

Carmi Member (ec). Fine-grained lacustrine silts and clays are discontinuous over much of the old Lake Chicago Plain. They are more likely to be present adjacent to sandy beach ridges and near the Lake Michigan shoreline, where they grade into younger lacustrine deposits assigned to the Lake Michigan

Formation. Where the Carmi Member deposits are discontinuous, they are mapped in parentheses. When parentheses are omitted, boring data or soils mapping was generally available to confirm their presence. In addition to the areas formerly underlying Lake Chicago, lacustrine deposits are present in intermorainic areas, in closed depressions, and where ponding occurred along drainageways. In extreme northwest Cook County, where data were scarce, Carmi deposits were mapped on the basis of SCS mapping and topography.

Dolton Member (ed). Sandy beach ridges, which mark the position of former shorelines of Lake Chicago, are mapped as the Dolton Member of the Equality Formation. Dolton Member deposits include linear or curvilinear beaches, bars, and spits which often have topographic expression and may be clustered to form beach ridge complexes. In many cases, individual beach ridges could not be mapped, even at the $7\frac{1}{2}'$ scale, and the entire beach ridge complex is designated ed, even though it is recognized that, locally, Carmi Member deposits (ec) may occur between the ridges. In areas within the city of Chicago, many of the sandy beach ridges described by original settlers were apparently leveled during development of the area to form blanket deposits of surficial sand. These areas, which occur mainly in the Loop and Jackson Park quadrangles ($7\frac{1}{2}'$), are also mapped ed. It is interesting to note that Alden's geologic map for the Chicago 15' Quadrangle (1909) indicates a complex pattern of beach ridges that did not have topographic expression even in his day.

Parkland Sand (pl). Wind-blown sand which occurs in dunes on the Lake Chicago beach ridges is mapped as the Parkland Sand (pl). Most of this well-sorted, fine to medium fine-grained sand is derived from Dolton deposits which have been secondarily transported by wind. Parkland deposits are mapped mainly by their topographic expression in the southern and southwestern parts of the county. They grade into and cannot always be distinguished from associated Dolton deposits.

Depressional Deposits, Alluvium and Shoreline Sediments

Localized, poorly-drained depressions on the surface of till plains, morainic upland, or outwash plains are sites of accumulation for accretion gley (ag), peat (gl -- Grayslake Peat), or colluvium (py -- Peyton Colluvium). All of these deposits are generally fine-grained and may contain significant amounts of organic matter. The mapping of peat (gl) is limited to desposits where decayed organic matter is predominant. However, all gl deposits are not thick or extensive enough to be utilized as a peat resource. Accretionary materials deposited in isolated depressions are mapped as accretion-gleys (ag); these are often adjacent to sites of peat accumulation. Peyton Colluvium (py) includes materials deposited along valley sides by downslope gravity movements.

The deposits of modern rivers, which are mainly fine-grained and poorly-drained in Cook County, are collectively mapped as the Cahokia Alluvium (c); these may grade into Peyton Colluvium along valley sides. Alluvium is not mapped along many portions of the Chicago and Calumet Rivers, where the channel is periodically dredged to permit the passage of ships and barges. In the central Loop area, data collected by Peck and Reed (1954) suggested the presence of alluvial channels which are documented by deposits of fine sand and organices; since the exact configuration of these channels and their affinities to other geologic deposits is unknown, they are mapped in parentheses (c).

Lake Michigan Formation

Very localized, modern lake deposits are mapped in areas adjacent to the Lake Michigan shoreline. In the central Loop area, made-land areas east of Michigan Avenue are generally mapped as fill (m) over undifferentiated Lake Michigan Formation (lm). Along the North Shore, linear deposits of modern beach sand are included in the Ravinia Sand Member of the Lake Michigan Formation (lmr).

Bedrock

Except for a small area underlying northwest suburban Des Plaines,

the bedrock of Cook County consists entirely of Silurian dolomite. Because of the eastward dip of the rock strata in northeastern Illinois, Cook County is underlain largely by the Racine Formation, the youngest Silurian formation in the region. The Racine includes a number of organic reefs, which consist of a core of massive, high-purity dolomite flanked by dipping dolomite beds. Interreef strata may be argillaceous and contain chert or shale interbeds. The dolomite has been extensively quarried where it lies near the land surface, mainly along the Sag and lower Des Plaines Valleys or above the erosion-resistant reef structures, which are preserved as topographic highs on the Silurian surface. Surface topography may reflect the circular contours of shallowly buried reefs.

In the Des Plaines area, various rock formations (generally older than the Silurian dolomite) underlie the glacial drift. However, these occur at depths greater than 20 feet and are thus not mapped.

TERRAINS

The landscape in Cook County has been subdivided into three principal terrains, uplands, plains and lowlands, indicated as A, B and C, respectively, on plate 2 (See Vol. I, p 22-24). These terrains were identified on the basis of relative elevation, slope characteristics, and sequence and character of the underlying material.

In general, land surface is highest in the extreme northwestern portion of Cook County where the only area of upland terrain (A) is mapped. In most of the rest of the northern part of the county, the landscape slopes gradually toward Lake Michigan to the east, broken by north-south trending valleys. The most significant of these valleys is the Des Plaines Valley, which is mapped as a lowland (terrain C).

Probably the most prominant terrain feature of Cook County is the low flat Lake Chicago plain. It is mapped as Terrain C (lowland), and covers most of the central and southeastern portion of the County. This lowland area slopes gradually toward Lake Michigan from its highest parts along its northwestern, western and southwestern margins.

Terrain B (plains) is mapped throughout the remainder of the west-central and southwestern portions of the county. The only exceptions are two areas mapped as lowlands: 1) the continuation of the Des Plaines River Valley out of the Lake Michigan lowland area into northeastern Will County and 2) the Sag Channel which joins the Des Plaines Valley from the east.

Except for sand and gravel deposits underlying the northern and western segments of the Des Plaines River Valley, the silty clay Wadsworth Till is the principal material underlying all terrains of Cook County within 20 feet (6 meters) of land surface. Many thin, patchy areas of Grayslake Peat and related materials are scattered over all terrains. Numerous areas of lake deposits (Equality Formation) are also present throughout the county but are concentrated in the area covered by the Lake Chicago lowland. In most of these areas, however, the Wadsworth Till is also within 20 feet (6 meters) of land surface. Therefore significant topographic changes were more often the deciding factor in mapping the terrains of Cook County although material boundaries were utilized where generally coincident.

NATURAL AND ARTIFICIAL RECHARGE

The area covered by Cook County probably provides relatively small amounts of recharge to the shallow aquifer system which includes glacial drift aquifers and the Silurian dolomite. Based on the hydrologic principles

and potential ground-water flow systems described in Volume I of this series, Terrain C (lowlands) is principally a regional discharge area. Since approximately half of Cook County is mapped as Terrain C, this factor in itself would appear to restrict the area available for significant natural recharge to the shallow aquifer system. At present, much of Cook County is highly urbanized, and artificial drainage of the landscape further limits the amount of recharge from rainfall which is available to move downward into the ground-water reservoir.

It is probable that portions of the upland and plain terrains (A and B) in northern Cook County and the areas mapped as plains (area B) in the west-central and southwestern portions of the county may be providing some recharge to the shallow aquifer system. Although the predominant geologic materials covering most of Cook County are the silty clay Wadsworth Till or other fine-textured deposits, upland and plain areas underlain by these materials are still capable of contributing significantly to natural recharge, at least locally, in Cook County. In part this recharge may be facilitated by the presence of a relatively permeable surface soil and fractures in the upper portion of the till.

Although significant ground-water discharge is generally to the lowland areas (C), there is also good indication that ground-water flow enters Lake Michigan (Cartwright et al, 1976). Although there is hydrogeologic evidence that the upland terrains of Kane and McHenry Counties may contribute most to natural recharge regionally, some recharge probably originates in the uplands and plains adjacent to the lowland areas of Cook County. It is likely that natural ground-water flow is generally eastward, with some discharge into the Des Plaines and Chicago River systems.

DRAINAGE CONDITIONS

Plate 2 shows large areas of poorly-drained soils in northern and southwest suburban Cook County. These poorly-drained soils were interpreted directly from recent SCS soils mapping, which omitted highly urbanized areas in the county. The poorly-drained areas occur along drainageways, where they reflect local ground-water discharge; on the old Lake Chicago Plain, where they reflect the lack of topographic relief; in morainic areas; where they reflect localized depressions resulting from the lack of integrated drainageways; and in intermorainic areas, where they reflect localized lacustrine deposits. Poorly drained conditions in Cook County are aggravated by the widespread occurrence of fine-grained surficial materials (ww, ec, ag, gl, c), which retard infiltration, and by the many relatively impermeable surfaces, which increase run-off.

Areas of Cook County which were not included in the detailed soils mapping generally lie on the Lake Chicago Plain and are naturally poorly-drained. Even though most of this area is served by storm sewers, a major run-off event will cause flooding in basements and in low-lying viaducts and streets. The Metropolitan Sanitary District of greater Chicago (MSD) has begun to implement its deep Tunnel and Reservoir Plan (TARP) to alleviate this condition (e.g. see Buschbach and Heim, 1972). This plan calls for a series of large diameter underground tunnels to temporarily store the increase in combined sewer effluents after major storm events. Major benefits from this system will include (1) improved surface drainage, since the existing combined sewer system will not be overloaded after a major storm; and (2) improved water quality in drainageways which receive sewage treatment plant effluent, since the present system permits relatively untreated effluent to be discharged when the system becomes overloaded.

INTERPRETATIONS FOR PLANNING

Waste Disposal and Pollution Potential

The types of maps, mapping criteria, and map limitations were discussed in volume 1. In Cook County, only the map for land burial of wastes (plate 4a) is drawn for the entire county. In part, this reflects the widespread areas of thick till in the county, which are generally favorable for the placement of sanitary landfills. In addition, there is a pressing need for landfill sites that are convenient to the Metropolitan area. The other four maps in this series - namely, the maps for surface spreading of wastes (plate 4b), for septic systems (plate 4c), for fertilizers and soil additives (plate 4d), and for herbicides and insecticides (plate 4e) - are limited to the north-northwest and south-southwest suburban areas covered by detailed soils mapping. The highly urbanized character of the central portion of Cook County precludes the applicability of mapping for agricultural uses or for surface spreading of wastes. County wide mapping for septic systems is also generally not applicable since most of central Cook County is sewered.

Land Burial of Wastes (including sanitary landfills)

Plate 4a indicates conditions in Cook County for land burial of wastes. Of major concern are those areas where the Silurian dolomite (shallow bedrock aquifer) lies within 25 or 50 feet of the land surface: these areas are labeled A and C, respectively, and are generally located south of T. 40 N. Frequently, in such areas, the shallow bedrock aquifer is overlain by saturated sand and gravel which is hydrologically connected with it. For mapping purposes, since the shallow bedrock is considered the more critical condition, the shallow sand and gravel is not mapped separately. A and C areas are generally located along the Sag and Southern Des Plaines Valleys and above buried reef structures on the Silurian surface.

B and D areas indicate sand and gravel aquifers within 25 or 50 feet, respectively, of the land surface. Major areas included in category B are the Fox River outwash plains and related ice-contact deposits in extreme northwestern Cook County; some of these deposits may be locally drained to the top of the underlying clay till. Surficial sands and gravels in the northern portion of the Des Plaines River valley train are also included in area B. It is doubtful that this valley train constitutes a significant surficial aquifer in Cook County. Much of the surrounding area is highly developed with community water supplies from deep bedrock aquifers. Also, available data suggests that the valley train deposits exhibit a wide range of grain-size properties and locally may thin to insignificant dimensions. However, much of the northern Des Plaines Valley proper is included in the Cook County Forest Preserve District (FPD), which may have some small yield wells finished in the valley train. This is the major reason that this area is included in category B. Practically speaking, it is highly unlikely that major tracts of FPD land in this area would be utilized for any type of waste disposal operations, including land burial of wastes; a possible exception might be refuse that was mounded to develop recreational facilities for skiing or sledding.

Other areas of surficial sand and gravel in Cook County, namely the Lake Chicago beach ridges (ed) and valley train deposits (hm) in the southern Des Plaines and Sag Valleys, are not mapped in category B since they do not constitute surficial aquifers. These deposits are generally thin, artificially or naturally drained, and located within areas so highly urbanized that any water contained in them may have severe water quality problems. Much of the southern Des Plaines and Sag Valleys are included in areas of shallow bedrock (categories A and C); the beach ridges are generally included in areas mapped as E (described below).

D areas (sand and gravel aquifers within 50 feet of the surface) are sparingly mapped in Cook County. Buried sands and gravels in extreme northwest Cook County and limited areas in T. 41 N., R. 11-12 E., are included in this category. The areas mapped as D in T. 41 N., R. 11-12 E., have a high probability of containing localized sand and gravel aquifers near the middle of the glacial drift sequence, which is generally less than 100 feet thick.

Most of Cook County is mapped as category E, which includes those areas where impermeable materials (mainly Wadsworth Till) are generally greater than 50 feet thick. Many of these areas are relatively flat and poorly-drained so that provisions have to be made to prevent surface drainage into land burial operations. As indicated above, surficial sand and gravel may be locally present in areas mapped as E; such areas generally require measures to seal off the permeable surficial materials from the landfill operation. Many sanitary landfills in Cook County have been successfully developed in old clay pits which mined either ww or ec materials.

Areas that correspond to the categories described above but are poorly drained are mapped A', B', C', D' and E', respectively. The poorly drained areas in north-northwest and south-southwest suburban Cook County were generalized from the detailed soils maps. The poorly drained areas in central Cook County were delineated from general terrain and material characteristics which correspond to the poorly drained areas included in the detailed soil survey.

Finally, it must be stressed that any prospective site for land burial of waste must be individually evaluated. The development of specific sites is often a sensitive matter in Cook County and may be based on many factors other than the general suitability of the earth materials. In some cases, unsuitable sites may be engineered to conform to state requirements for licensing.

Surface Spreading of Wastes

Plate 4b differentiates areas where there may be pollution problems resulting from the spreading of wastes on the land surface or in the top soil. It is to be used primarily for the placement of industrial and sewage wastes, by any method, on the land surface. In Cook County, as in other counties in this study, the factors considered in mapping include depth to sand and gravel aquifers, terrain, drainage conditions, and soil characteristics - particularly hydraulic conductivity. Mapping in Cook County was limited to the suburban areas included in the recent SCS soil survey.

Areas which have the most severe limitations for surface spreading of wastes are those areas where bedrock is exposed at the ground surface (area A) or occurs within 20 feet of the surface (area D). These areas occur mainly in southern Cook County along the southern Des Plaines River Valley and the Calumet-Sag Channel. The potential for ground-water pollution is high in these areas.

Remaining portions of Cook County are included either in area B, which is characterized by surficial sands and gravels, or in area C, which is generally characterized by poorly drained lowlands or plains underlain by relatively impermeable surficial materials. Areas mapped as B (surficial sands and gravels) occur mainly along major drainageways (Des Plaines and Fox River Valleys) and the Calumet-Sag Channel. As discussed under Land Burial of Wastes, many of these surficial sands and gravels probably cannot be considered surficial aquifers. However, since these areas are characterized by high infiltration rates, they must be differentiated for surface spreading of wastes. Areas mapped as category C mainly include large portions of Cook County which are underlain by Wadsworth Till (ww). Wadsworth Till is very clayey, has a low hydraulic conductivity, and is frequently characterized by poor drainage. Locally, slopes may exceed 7 percent in morainic

areas. Since waste materials either infiltrate very slowly in areas of low relief or tend to run off of steeper slopes, acceptability is the major problem for surface spreading of wastes in areas mapped as C.

Mapped portions of Cook County do not include any areas without limitations for surface spreading of wastes. Thus, as in Lake County, there are no E areas mapped.

Waste Disposal by Septic System

Conditions for waste disposal by septic systems for areas of Cook County where detailed soils information was available are shown on Plate 4c. The major factors in outlining these conditions are potential for pollution of shallow aquifers, drainage characteristics of the materials and terrain characteristics. Mapped portions of the county do not include any areas without limitations for septic systems.

Areas with the greatest limitations (area A) are where surficial sands and gravels occur and high infiltration rates may cause rapid movement of pollutants into the shallow ground-water system. These areas occur mainly along the Fox River Valley, the northern and southern portions of the Des Plaines River Valley, the Calumet-Sag Channel, and on scattered Lake Chicago Beach Ridges.

Area B delineates areas where sand and gravel or dolomite bedrock occurs within 20 feet of the surface. The most critical areas are those where septic wastes could move rapidly through sand and gravel directly into the Silurian dolomite (shallow bedrock aquifer). As in area A, the potential for rapid infiltration into the shallow ground-water system or shallow aquifers is high. Most B areas in Cook County occur adjacent to A areas along major drainageways.

Areas mapped as C include upland areas with steep slopes along morainic ridges in western Cook County, lowland areas subject to flooding

along drainageways, and discharge areas and poorly drained areas within former lake plains and in depressional areas. In general, acceptance of wastes by earth materials may be a problem in these areas.

Remaining areas in Cook County are generally underlain by Wadsworth Till and are mapped as area D. Since the Wadsworth Till has a low hydraulic conductivity, some problems with acceptance of wastes may be a limiting factor, but this restraint is generally less severe than in area C.

Application of Fertilizers and Soil Additives

Plate 4d indicates conditions for application of fertilizers and soil additives in areas of Cook County where detailed soils information was available. The most severe limitations exist in areas where surficial sands and gravels (area A), sand and gravel within 20 feet (area D), and shallow bedrock aquifers (area B) allow excess fertilizers and soil additives to easily enter the ground-water system. The A and B areas are the most critical. In Cook County, these occur mainly along major drainageways, including the Fox River, Des Plaines River, and Calumet-Sag Channel.

Areas mapped as C include those areas where runoff problems or ponding may occur due to materials of low hydraulic conductivity at the surface. In Cook County, these include large areas of Wadsworth Till, poorly drained materials in lowlands, and former lake deposits.

Application of Herbicides and Insecticides

Conditions for application of herbicides and insecticides for north-northwest and south-southwest suburban Cook County are mapped on Plate 4e. The limitations for their application are very similar to those for fertilizers and soil additives since both are applied at or near the ground surface and are subject to the same natural processes of precipitation and runoff.

Areas characterized by sand and gravel deposits at the surface or within 20 feet are mapped as area A. These occur along the major drainageways and on scattered Lake Chicago beach ridge deposits.

Remaining areas in Cook County are included in area B, which includes lowlands or plains underlain by low hydraulic conductivity materials. These materials include Wadsworth Till, lake deposits, alluvial deposits, and poorly drained depressional materials. Areas mapped as B occur in major portions of the county.

Land Utilization

Material properties, such as texture and bearing capacity, and terrain characteristics, such as drainage and depth to the zone of saturation, affect the suitability of land for different uses. Two maps were prepared (plates 5a and 5b) to evaluate both terrain and material characteristics for two specific types of land use - community development and roadway construction. These maps should be used in conjunction with the USGS flood hazard maps and the poorly drained soils map (plate 3).

For both maps, a rigid classification of areas (i.e., good, marginal, poor) was purposely avoided; rather, these interpretive maps should be used as one source of technical input for planning decisions, along with other types of nongeologic data. It is assumed that specific construction projects will include an adequate subsurface investigation program.

Construction Conditions for Community Development

Plate 5a indicates construction conditions for community residential development. Major problems in Cook County associated with land use for community development include poor surface drainage, flooding along major drainageways, and the presence of deposits which have low bearing capacity such as peat or accretion-gley.

In general, the constraints for community development listed on Plate 5a decrease in alphabetical order. However, areas labeled as C or D

that are located along drainageways may be subject to infrequent flooding and thus may have rather severe constraints for community development. Several small to moderate sized areas underlain by shallow bedrock are present in central and southern Cook County. These are located mostly along the Des Plaines River and Sag Channel. Areas of shallow bedrock exhibit very high bearing strengths but are extremely difficult to excavate and do not permit septic system construction.

Problems of poor drainage, flooding, and low bearing capacity materials are not limited to lowland areas (mainly Lake Chicago Plain) in the eastern part of the county. In the topographically higher morainic areas of the county, these problems also locally exist due to poorly developed drainageways and the presence of surface depressions on predominantly fine-grained materials. With the exception of these relatively small areas, the bearing strengths of surficial materials in morainic areas are generally adequate for residential construction and can be easily excavated for foundations and utility trenches. In the few undeveloped areas of the county, acceptance problems for septic systems are likely to be encountered in both higher areas, because of low permeability surface materials, and in lower areas, due to a shallow depth to the top of the zone of saturation.

Erosion along the Lake Michigan shoreline is a significant local problem which limits additional development, particularly in the area immediately adjacent to the Lake Michigan bluffs of northeastern Cook County (DuMontelle et al., 1975, Berg and Collinson, 1976).

Construction Conditions for Roadways

Plate 5b indicates construction conditions for roadways. The principal tasks of roadway planners are to locate areas of poor drainage, areas of low bearing capacity materials, and areas subject to seasonal flooding. They must also determine the amount of material to be excavated or replaced in cuts or fills and locate potential sources of borrow that are close to the proposed construction.

In general, the constraints for roadway construction listed on Plate 5b decrease in alphabetical order. Roadway construction in areas mapped as A may require: (1) special treatment to provide proper support where the surficial material has low strength, (2) construction of embankments to grades above expected flood levels, and (3) construction of structures over waterways. In the remaining areas, cuts and fills may be needed, but the material from cuts should be suitable for common backfill.

NATURAL RESOURCES

Ground-Water Resources

Although Cook County lies adjacent to Lake Michigan, ground water has played a significant role in the development of the county. Today, ground water is still a significant factor in continued growth and development in Cook County. Even though the City of Chicago and many municipalities in Cook County ohtain water supplies from the Lake, some industries and municipalities obtain water supplies from wells. In 1970, approximately 8.6 percent of the total water supply in Cook County was supplied by wells (NIPC, 1974).

Information on the ground-water geology of Cook County and the remainder of northeastern Illinois has been presented in previous studies (eg. Suter, et al. 1960, Hughes, et al. 1966). The principal water-yielding units in Cook County are the deep sandstone aquifers and the shallow dolomite aquifer; in 1970, these units together supplied about 96 percent of the total ground water used in Cook County (NIPC, 1974). The remainder was supplied by glacial drift aquifers. A general description of these units can be found in volume I of this series.

The shallow dolomite aquifer (Silurian) and the glacial drift aquifers are closest to the surface and together form a shallow system.

Water is recharged to these aquifers by local rainfall. In Cook County, glacial drift aquifers are utilized mainly in the extreme northwest and south-southwest parts of the county. The significant glacial drift aquifers in southern Cook County generally directly overlie the Silurian dolomite in many areas of the county. The bulk of the glacial deposits are composed of relatively impermeable glacial till, and no significant aquifers are present within the glacial drift. The Silurian dolomite is a locally significant aquifer, particularly in the northern and southern thirds of the county. Wells are usually finished in the upper 75 feet (23 meters) of the dolomite since this part contains more solution openings along fractures and is thus more productive.

The deep sandstone aquifers include the Ordovician-age St. Peter Sandstone and the Cambrian-age Ironton-Galesville and Mt. Simon Sandstone. Hughes et al., 1966, summarized their properties and occurrence.

Sand and Gravel Resources

Due to its relatively restricted occurrence and extensive urbanization, sand and gravel available for use is limited in Cook County. Some of the most accessible and desirable deposits have been depleted or eliminated due to urban expansion or legal restrictions.

The most significant deposits occur in the extreme northwestern part of the county, east of the Fox River, and along the Des Plaines River Valley in the northern and southwestern parts of the county (see plate 1, areas mapped h, wh-o and w-o). However, only small portions of these areas may still be available, of useable quality or economically recoverable.

Ekblaw and Lamar (1964) summarized the potential sand and gravel resources of northeastern Illinois, including Cook County. At present, there are only five active pits in Cook County (Malhotra and Smith, 1976).

Peat Resources

At present there are no commercial peat operations in Cook County. It is possible that a few of the areas mapped as Grayslake Peat (gl) on Plate 1 in northern and southeastern Cook County may be of commercial value.

Clay Resources

Clay resources in Cook County, including the Wadsworth Till (ww) and the Carmi Member of the Equality Formation (ec), are generally ubiquitous and are suitable for the manufacture of Chicago Common brick or tile. Historically, since the City of Chicago Building Code severely limited the construction of wood frame buildings after the Chicago Fire (1873), the county had, at one time, a thriving brick industry. Today, only two clay pits remain active; these are:

American Brick Co. Pit, east edge Dolton, Section 2, T. 36 N., R. 14 E., and Section 35, T. 37 N., R. 14 E.

Illinois Brick Company, Blue Island, Section 25, T. 37 N., R. 13 E.

Many of the remaining clay pits have been utilized as sanitary landfills and were discussed in the previous section on land burial of wastes.

Dolomite Resources

South of the north line of T. 39 N., quarries have been developed in buried bedrock hills that have little or no drift cover. The buried hills generally represent occurrences of the more resistant, high-purity reef-type dolomite (Racine Formation) that has withstood glacial scouring and stream erosion; however, not all quarries display the classical reef structures. Other quarry sites have been developed in the Silurian dolomite outcrop belt along the Des Plaines River in the southwestern part of the county.

These quarries are excavated in formations below the Racine which include both pure and impure dolomites. North of T. 39 N., the glacial drift is generally greater than 50 feet thick and surface quarrying is, at present time, not economically feasible.

Operating quarries are listed below. All but two are in the Racine Formation -- the Donohoe quarry which is the Joliet Formation along the Des Plaines River, and the Bellwood quarry which begins in the lower part of the Racine, but also includes the underlying Sugar Run, Joliet, and Kankakee Formations.

	Company	Quarry	Town	Sec-T-R
01.	R. P. Donohoe	Donohoe	Lemont	SW¼ 19-37N-11E
02.	Material Service	Federal	LaGrange	NW¼ 10-38N-12E
04.	Material Service	Thornton	Thornton	NE¼ 33-36N-14E
18.	Material Service	Riverside	Lyons	SE¼ 2-38N-12E
78.	Vulcan Materials	McCook	McCook	SE¼ 10-38N-12E
86.	Hillside Stone	Bellwood	Hillside	NE¼ 17-39N-12E

Figure 1 shows bedrock outcrops and areas of thin glacial drift that may be considered potential quarry sites. Expansion of the quarrying industry in Cook County seems doubtful (except for the possibility of underground mining) because of the highly urbanized character of the county.

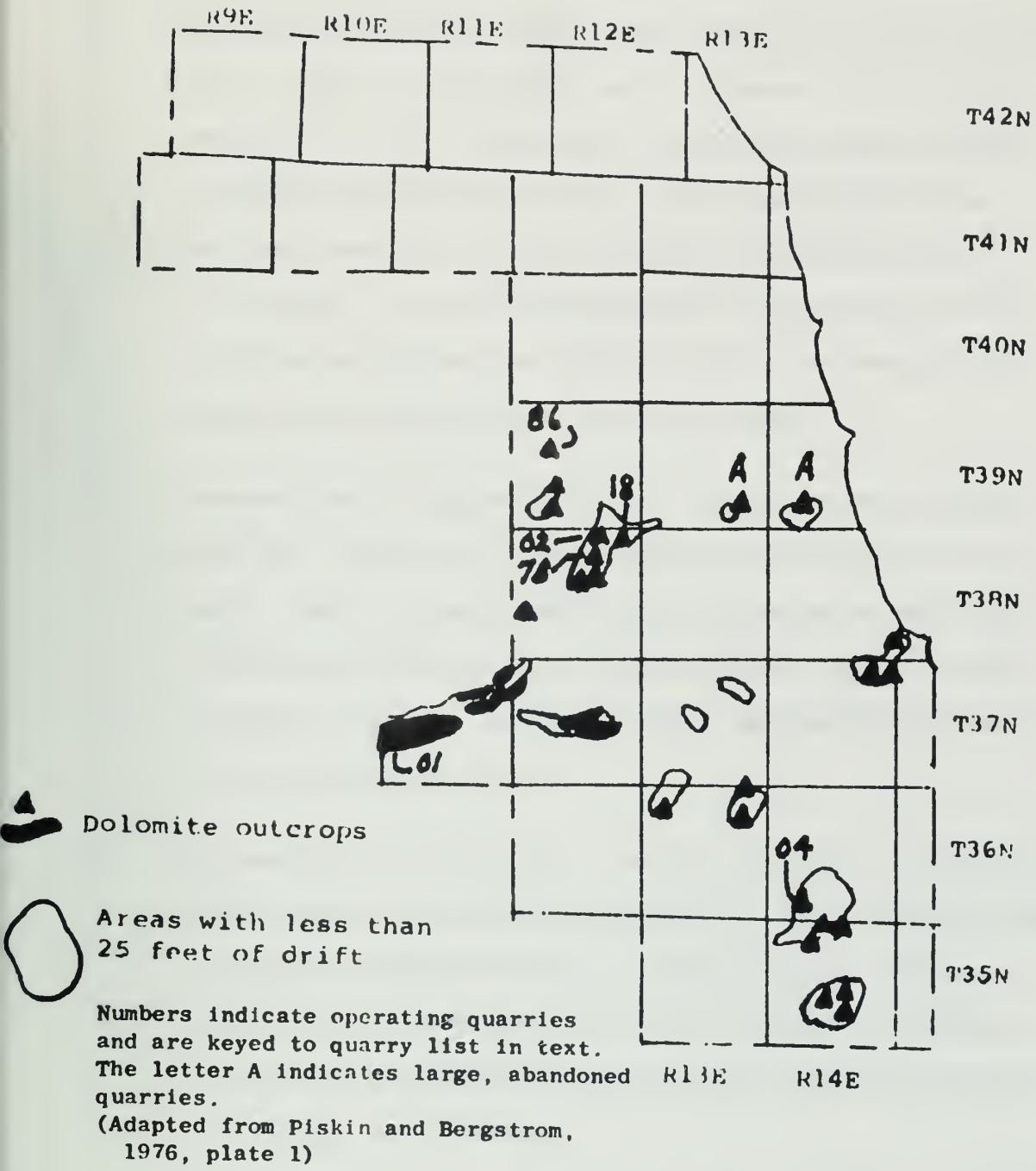

FIGURE 1 Map of Cook County showing locations of dolomite bedrock exposures and areas with thin glacial drift.

SITES OF GEOLOGIC INTEREST

1. Blue Island Ridge 37N, 13-14E. This north-south trending ridge was an island in Lake Chicago and is believed to be a southern remnant of the Park Ridge Moraine. The western edge includes shoreline dune and beach sands. At 87th and Western in the Dan Ryan Woods area, a wave-cut cliff in Wadsworth Till is well exposed. The top of Blue Island is approximately 70 feet above the surrounding Lake Chicago Plain. The town of Blue Island lies at the southern edge of the ridge.

2. Thornton Quarry of Material Service Corporation 28-29, 32-33, 36N, 14E. This is one of the largest quarry operations in the world. Reef core and flanking beds of Silurian dolomite are spectacularly exposed. The Tri-State Tollway (I-294) bisects the quarry; roadcuts reveal oppositely inclined beds as the reef structure is traversed.

3. Swallow Cliffs 21, 37N, 12E. From this vantage point, the Sag Valley, which was the prominent outlet for Lake Chicago drainage through the Valparaiso Moraine is easily reached. Today, no natural rivers occupy this broad valley; however, the Calumet-Sag Channel and the Sanitary and Ship Canal have been excavated in this part of the Valley.

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